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ABSTRACT

The Wechsler Intelligence Scale for Children - Revised (WISC-R) and the Wechsler Intelligence Scale for Children (WISC) were administered in counter-balanced order to 81 children aged 7-12 in New South Wales, Australia. Canonical correlation analysis showed the total redundancy values of WISC-R given WISC and WISC given WISC-R to be .58 and .61 respectively. The correlation between the first pair of canonical variates of the two tests was .97. The first canonical variates were found to be g-type factors and accounted for the major portion of the overlap between the two tests. Analyses of variance indicated significance for test form, order of administration and for the test form X order of administration interaction effect. WISC-R produced consistently lower intelligence quotient estimates than WISC, and all students to whom WISC-R had been administered first performed better on both tests than students to whom WISC had been administered first. The degree of similarity of the internal structures of the tests was investigated by factor analysis. A two factor solution representing verbal and performance factors was selected as the best solution for both WISC-R and WISC. (Author/RL)

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WISC-R and WISC:

A Study of Redundancy and Structural Comparability

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Abstract

The Wechsler Intelligence Scale for Children - Revised (WISC-R) and the Wechsler Intelligence Scale for Children (WISC) were administered in counter-balanced order to 81 children aged between 7 years 2 months and 12 years 6 months. The Ss were chosen from a sample of 49 government primary schools in New South Wales, Australia. Canonical correlation analysis showed the total redundancy values of WISC-R given WISC and WISC given WISC-R to be .59 and .61 respectively. The correlation between the first pair of canonical variates of the two tests was .97. The first canonical variates were found to be g-type factors and accounted for the major portion of the overlap between the two tests. Analyses of variance indicated significance for test form, order of administration and for the test form X order of administration interaction effect. WISC-R produced consistently lower IQ estimates than WISC, and all Ss to whom WISC-R had been administered first performed better on both tests than Ss to whom WISC had been administered first. These results, which will be discussed in relation to previous research, point to the fact that WISC-R and WISC are less similar than may have been expected. The degree of similarity of the internal structures of the tests was investigated by means of factor analysis. Principal factor and maximum likelihood factor analyses were computed on the correlation matrices of the scaled scores of the ten mandatory subtests. Factor solutions for 2, 3 and 4 factors were obliquely rotated. A two factor solution representing verbal and performance factors was selected as the best solution for both WISC-R and WISC, and this solution was highly congruent across methods of factor extraction and across tests.

The study on which I am reporting here was conducted as part of a series of comparative studies of WISC-R and WISC with Australian children, which began when WISC-R first became available in Australia. The aim in these studies was to investigate the similarity of the tests, both in terms of their equivalence as measures of intellectual performance, and their comparability on the basis of their internal, i.e. factorial structures. A number of different samples provided the data for these investigations.

I believe that the value of the particular data I am presenting today results from two aspects in which this part of the study differed from previous research:

1 The data were obtained from a representative sample of 'normal', i.e. non-referred subjects;

2 Both WISC-R and WISC were administered to all subjects. The study thus permitted the estimation of the degree of invariance of the factor structures of the tests in a situation in which the factor solutions are less sample dependent, than they would be in studies in which the factor solutions obtained from one of the tests, were compared with the standardization data of the other.

Previous studies of the magnitude of differences between scores on WISC-R and WISC have tended to focus on populations with special characteristics, e.g. mentally retarded children (Berry and Sherrets, 1975; Hamm et al., 1976; Rowe, 1977), highly intelligent children (Larrabee and Holroyd, 1976), juvenile delinquents (Solway, et al., 1976), low SES children (Hartlage and Steele, 1977) and children referred for psychological assessment (Brooks, 1977). Only a few studies (Davis, 1977; Rowe, 1976; Schwarting, 1976) addressed themselves to a more general, though geographically restricted, population. The results of these and other comparative studies (.e.g. Catron and Catron, 1977; Klinge et al., 1976; Silly, 1977 and others reviewed by Swerdlik, 1977) were consistent in showing WISC-R to be a more difficult test than WISC.

As was mentioned previously the aim of the present study was not restricted to the comparison of the difficulties of the two tests, but extended to an investigation of the degree of similarity of the obtained factor structures.

Most published factor analytic studies were based on the standardization data of WISC or WISC-R.

The two most frequently cited factor analyses of the WISC standardization data (Cohen, 1959; Silverstein, 1969) suggest two different factor structures.

Cohen (1959) reported a five factor solution defining two verbal comprehension factors and perceptual organization, freedom from distractability and quasi-specific factors. Silverstein (1969) concluded that a two factor solution, corresponding to verbal and performance factors, was more appropriate.

Factor analyses of the WISC-R standardization data have also resulted in varying solutions. Kaufman (1975) computed factor analyses of WISC-R by age group from the standardization data and compared the results to the previous factor analyses of the WISC standardization data. He reported that a two factor solution clearly defined verbal and performance factors, but argued that a three factor solution (corresponding to verbal, performance and freedom from distractability factors) would be more meaningful. He concluded that although the WISC-R and WISC factor structures were similar, the WISC-R structure was more stable across age and less dependent on the rotational techniques used in the factor analysis. In addition he argued that the WISC-R structure corresponded more closely to Wechsler's verbal-performance dichotomy. Silverstein (1977) factor analysed the WISC-R standardization data and reported that a two factor solution (corresponding to a verbal factor and a performance factor) was more stable across age, as indicated by congruence coefficients, than a three factor solution (comprising verbal, performance and freedom from distractibility factors).

Van Hagen and Kaufman (1975) factor analysed WISC-R data for 80 mentally retarded subjects. They obtained a three factor solution (consisting of verbal, performance and freedom from distractibility factors) from an orthogonal rotation and one oblique rotation, and a two factor solution (comprising verbal and performance factors) from a different oblique rotation. They concluded that the WISC-R factor structure which they obtained for retarded Ss was similar to those previously reported for WISC.

Other groups for which factor analyses of WISC-R were reported include students with learning problems (Lombard and Riedel, 1978; Schooler et al., 1978; Stedman et al., 1978), psychiatric patients (De Horn and Klinge, 1978) and American ethnic groups (Reschly, 1978). The findings of all these studies have supported the conclusion of Van Hagen and Kaufman (1975) that the factor structure of WISC-R is best described by a two factor (verbal and performance) or a three factor (verbal, performance and freedom from distractibility) solution.

The literature suggests, therefore, that the factor structures of WISC-R and WISC are similar, and that a two (verbal and performance) or three (verbal, performance and freedom from distractibility) factor solution could be most

appropriate. Only one previous study (Swerdlik and Schweitzer, 1978) has been reported, in which the comparison of the factor structures of the tests was based on WISC-R and WISC scores obtained from the same sample.

The sample consisted of 164 American children referred to school psychologists because of concern over their intellectual ability. Two and three factor principal component analyses for the twelve subtests of WISC-R and WISC were computed and the solutions were rotated using the Varimax criterion. The authors did not discuss the appropriateness of the two and three factor solutions according to any of the criteria normally used to determine the suitable number of factors for a set of data. In their interpretation of the factor solutions, the authors concluded that the two factor solution (comprising a verbal and a performance factor) was highly congruent across the two tests, as indicated by congruence coefficients of .99 and .98 for the first and second factors. The three factor solution was not found to be congruent across tests. A 'freedom from distractibility' factor emerged for WISC-R but not for WISC. However, as the authors did not discuss any of the guidelines used to determine the correct number of factors, it is difficult to assess the feasibility of a two factor solution for WISC and a three factor solution for WISC-R.

After a brief description of the design of the study, I shall present results of a comparison of the performance of subjects on both tests, and I shall conclude this paper with a discussion of the similarity of the factor structures of the tests.

Method

Sample and Procedure

The data were obtained from 81 Ss (36 boys and 45 girls) chosen from a sample of 49 government primary schools in the State of New South Wales, Australia. The tests were administered by school psychologists in counter balanced order. Forty-two Ss received WISC first; WISC-R was administered first to 39 Ss. Two months i.e. Christmas vacation, elapsed between the two test administrations. To save testing time the optional subtests Digit Span and Mazes, were omitted.

The age of the Ss at the first testing ranged from 7 years 2 months to 12 years 6 months. (SD = 1 year 3 months). New South Wales is the largest of the Australian States and contains approximately one-third of the total student population in Australia in the above age range.

Data Analysis

Canonical correlation analysis (Cooley and Lohnes, 1971) was used to make a comparison of the two tests and to investigate the overlap between them.

Canonical correlation analysis is a multivariate technique the use of which is recommended when the aim is to investigate the correlation between similar components in two sets of variables. A significant canonical correlation suggests that related components are present in the two sets of variables. The calculation of redundancy measures (Stewart and Love, 1968) makes it possible to assess the actual overlap between the two tests which is packaged in each canonical relationship.

The significance of the observed IQ score differences between WISC and WISC-R was assessed by way of a three factor unweighted means analysis of variance with one repeated measure (Winer, 1971) for each Verbal, Performance and Full Scale IQ scores. The 'Between Subjects' factors were order of test administration (WISC first of WISC-R first) and sex. The 'Within Subjects' factor was test form (WISC or WISC-R). The use of an experimental design of this nature was expected to be sensitive not only to those differences in performance which are due to differences between the two tests, but to reveal differences due to the order of administration and to performance differences related to the sex of the subject. The design also allows for the identification of differences which are due to interactions of these factors.

To compare the factor structures of the two tests principal factor analyses (with squared and multiple correlations as comminality estimates), and maximum likelihood factor analyses were computed. The decision to use two factoring methods resulted from Harris' (1967) concern that factor solutions be tested for stability across methods of factor extraction. Because factors representing human abilities are correlated, oblique rotation, BINORMAMIN (Kaiser and Dickman, 1959) was used. The ratio of number of subjects to number of variables was 4:1, i.e. within the guidelines suggested by Cattell (1952). The factor analyses were computed using the SOUPAC (University of Illinois, 1975) computer package.

Results

Redundancy

The results of the canonical correlation analysis (Cooley and Lohnes, 1971) are summarized in Table 1.

Table 1 Structure Coefficients for the Canonical Factors of WISC-R and WISC

	WISC										WISC-R									
Factor	I	II	III	IV	V	VI	VII	VIII	IX	X	I	II	III	IV	V	VI	VII	VIII	IX	X
Rc	.97	.79	.75	.61	.56	.49	.37	.33	.19	.15	.97	.79	.75	.61	.56	.47	.37	.33	.19	.15
I	.88	-.01	-.20	.06	-.01	.06	-.15	.03	.13	.37	.92	-.02	-.10	.07	-.04	.05	-.21	.01	.28	.14
C	.79	-.18	-.41	.05	.07	-.04	.17	.33	-.13	-.10	.80	-.12	-.29	-.02	.09	-.08	.31	.33	-.03	-.21
A	.84	.15	.22	.23	.26	-.15	-.03	-.23	-.14	-.12	.77	.33	.17	.28	.31	-.16	-.01	-.21	.07	-.15
S	.82	.07	-.02	-.43	.21	-.07	.20	.04	.20	-.05	.74	.15	-.01	-.48	.25	-.26	.08	-.22	-.13	-.03
V	.84	-.14	-.12	-.32	-.07	.16	-.19	-.15	-.16	-.22	.86	-.15	-.05	-.27	.06	.24	-.09	.03	-.14	-.27
PC	.49	-.35	-.06	-.00	-.24	-.07	.54	-.48	-.12	.21	.54	-.14	-.11	.18	-.31	.01	.34	-.57	-.25	.22
PA	.61	-.11	.11	.26	-.13	.27	.23	-.26	.52	-.25	.46	.04	-.17	.07	-.61	-.19	.06	-.25	.03	-.53
BD	.62	.14	.61	-.10	-.32	.04	.27	.19	.02	.00	.58	.20	.69	.04	-.34	.08	.15	.01	.02	.08
OA	.44	-.05	.45	.06	.03	.64	.33	.08	-.15	.24	.28	.08	.29	-.21	-.09	.60	.39	-.19	.48	-.10
Cd	.49	.78	-.02	.08	-.14	.24	.22	-.19	-.14	-.00	.48	.78	-.02	.10	-.21	.26	.02	-.09	-.18	.08
Variance Extracted Total 1.0	.49	.08	.09	.04	.03	.06	.07	.06	.04	.04	.45	.08	.07	.05	.08	.06	.05	.06	.04	.05
Factor Redundancy Total .61	.46	.05	.05	.02	.01	.01	.01	.01	.00	.00	.42	.05	.04	.02	.03	.01	.01	.01	.00	.00

	Factor I	Factor II	Factor III	Factor IV	Factor V	Factor VI	Factor VII	Factor VIII	Factor II	Factor X
Latent Root	.934	.619	.557	.369	.310	.219	.134	.112	.034	.022
x^2	409.73	220.83	153.74	97.14	65.18	39.37	22.18	12.18	3.94	1.52
df	100	81	64	49	36	25	16	9	4	1
p	.001	.001	.001	.001	.005	.05	NS	NS	NS	NS

The correlation between the first pair of canonical variates of the two tests was .97. The redundancy for WISC-R given this first canonical variate of WISC was .45. The redundancy for WISC given the first canonical variate of WISC-R was .49. This first pair of canonical variates extracted 45 per cent and 49 per cent of the total variance of WISC-R and WISC respectively.

The canonical analysis yielded five other significant pairs of canonical variates, none of which yielded a redundancy value above .05. This indicates that little overlap of the tests is contained in factors beyond the first one. None of the canonical variates beyond the first pair extracted more than nine per cent of variance. Inspection of Table 1 suggests these first canonical variates to be g-type factors of their respective tests.

The redundancy for WISC-R given the first canonical variate of WISC and the redundancy for WISC given the first canonical variate of WISC-R were .45 and .49 respectively. The total redundancy of WISC-R given WISC and vice versa were .58 and .61. The first pair of canonical variates therefore account for most of the overlap between the two tests. It is not surprising to find a g-type factor to account for the major portion of the information overlap of the two tests. Wechsler (1949, 1974) designed both WISC and WISC-R as g-type tests of general intelligence.

The total redundancy values of .58 and .61 for WISC-R given WISC and WISC given WISC-R respectively show that the overlap of the tests is less than may have been expected for a test and its revised version. In the present study, performance on WISC predicted only 58 per cent of WISC-R. Only 61 per cent of WISC performance was predicted by WISC-R. In a previous study (Rowe, 1977) the total redundancies of WISC-R given WISC and vice versa were .77; in this case leaving 23 per cent of the variance in either test unaccounted for by the other.

These findings stress the importance of multivariate procedures in a study of this type. Inspection of the simple correlations of the performances on the two tests and failure to apply the redundancy statistics may have led to the acceptance of a highly inflated measure of similarity of the tests.

Although the amount of overlap of WISC-R and WISC is less than may have been expected, the amount and the structure of the information overlap between the two tests as revealed in the present and previous studies would

seem sufficient t' justify the opinion that WISC-R and WISC cover common ground.

The tests are by no means identical but they are similar in structure and in content.

Table 2 shows simple correlations between corresponding subtests of WISC-R and WISC and between Full Scale, Verbal and Performance IQ scores.

Table 2 Intercorrelations Among Corresponding Subtests and IQs of WISC-R and WISC

Subtest	Correlation
Verbal	
Information	.82
Comprehension	.78
Arithmetic	.80
Similarities	.76
Vocabulary	.80
Performance	
Picture completion	.51
Picture arrangement	.33
Block design	.76
Object assembly	.41
Coding	.76
Full Scale IQ	.90
Verbal IQ	.94
Performance IQ	.70

Analysis of Variance

The analysis of variance, summarized in Table 3, showed the main effect for test form (WISC-R or WISC) to be significant for Verbal IQ ($p < .01$), Performance IQ ($p < .001$) and Full Scale IQ ($p < .001$).

Table 3 Summary of Analyses of Variance

Source	SS	df	MS	F
Full Scale IQ				
Between Subjects				
Order	2983.70	1	2983.70	7.32*
S's within groups	31370.70	77	407.41	
Within Subjects				
Form	482.13	1	482.13	31.97**
Order X Form	552.03	1	552.03	36.61**
S's within groups X Form	1161.03	77	15.08	
Verbal IQ				
Between Subjects				
Order	1813.27	1	1813.27	3.47NS
S's within groups	40235.65	77	522.54	
Within Subjects				
Form	156.74	1	156.74	9.37*
Order X Form	2.36	1	2.36	.14NS
S's within groups X Form	1287.35	77	16.72	
Performance IQ				
Between Subjects				
Order	3331.17	1	3331.17	11.89**
S's within groups	21576.92	77	280.22	
Within Subjects				
Form	780.73	1	780.73	22.92**
Order X Form	1867.12	1	1867.12	54.80**
S's within groups X Form	2623.45	77	34.07	

* $p < .01$ ** $p < .001$

The unweighted means are shown in Table 4.

Table 4 Unweighted Cell Means and Standard Deviations for Full Scale, Verbal and Performance IQ

	Full Scale IQ				Verbal IQ				Performance IQ			
	WISC	SD	WISC-R	SD	WISC	SD	WISC-R	SD	WISC	SD	WISC-R	SD
WISC First	105.89	15.06	106.14	14.24	105.02	17.09	103.23	16.27	105.82	11.96	108.30	12.22
WISC-R First	118.59	14.25	111.20	14.30	112.19	16.38	109.91	15.11	122.23	13.09	110.66	13.35
Total Sample	112.24	15.92	108.67	14.37	108.60	17.06	106.57	15.97	114.03	14.83	109.48	12.72

In every case the mean score for WISC-R is lower than the mean score for WISC, suggesting that WISC-R was the more difficult test.

The main effect for order of administration was significant for Performance IQ ($p < .001$) and for Full Scale IQ ($p < .01$), and approached significance for Verbal IQ ($p = .066$). This result indicates that the performance of subjects, to whom WISC-R had been administered first, was better on both tests than the performance of subjects to whom WISC had been administered first.

The test form X order of administration interaction effect was significant for Full Scale IQ ($p < .001$) and for Performance IQ ($p < .001$). Reference to the unweighted mean scores in Table 4 shows that the differences between WISC-R and WISC IQ scores were greatest when WISC-R was administered first.

None of the other effects were statistically significant, indicating that no difference was found in performance between boys and girls, or in the interactions of sex with test form and/or order of administration.

The comparability of WISC-R and WISC was further investigated by age and IQ levels. The relationship between the two tests as reported above for the total sample was found to be constant across different ages and IQ levels.

To summarize, it can be said that the present study supported previously published findings that performance on WISC-R is consistently lower than performance on WISC.

The here observed differences between WISC-R and WISC IQ scores of 3.57 points for Full Scale IQ, 2.03 points for Verbal IQ and 4.55 points for Performance IQ are somewhat lower than those reported in most American studies. In the latter studies differences ranged from one to ten points with an average difference of 6 points for Full Scale IQ, 5 points for Verbal IQ and 7 points for Performance IQ. The two previous Australian studies (Rowe, 1976, 1977) reported differences of 5, 4 and 5 points for EMR subjects and 7, 6 and 7 points for normal adolescents on Full Scale, Verbal and Performance IQ scores respectively. Although the differences observed in the present study were smaller than those reported previously, the findings of the present study are consistent with most of the previous American studies, exhibiting the greatest differences in Performance IQ and the smallest differences in Verbal IQ. Both previous Australian studies found equal differences of Full Scale and Performance IQ scores and a smaller difference between Verbal IQ scores.

The finding that subjects to whom WISC-R had been administered first performed better on both tests than subjects to whom WISC had been administered first supports the findings of Klinge et al., (1976) who used an analysis of variance design which was very similar to that used in the present study, and those of Davis (1977). The exact nature of this difference is unclear. Davis (1977) suggests that WISC-R provides a greater learning experience than WISC. In relation to the present findings, this would mean that subjects may have learned more during the actual administration of WISC-R than they did during the administration of WISC. Thus the amount of learning or transfer effect exhibited on the second test would partially depend on which test is administered first.

The average increase in IQ scores on WISC was 7.39 Full Scale points when WISC-R was administered first. However, when WISC was administered first, the average gain in Full Scale IQ score on the WISC-R was only 0.25 points. Similarly, increase in Performance IQ scores was 11.57 points when the WISC-R was administered first, but only 2.48 points when the WISC was administered first. An increase in IQ score would usually be expected on the second test administration due to practice effects and learning. However, if the WISC and the WISC-R were identical tests, practice effects should be equal regardless of which test is administered first. The differential gains in IQ score depending upon the order of administration and the test form provide further evidence in support of the hypothesis that WISC-R is a more difficult test than WISC.

The results of the analyses of variance performed in the present study are consistent with those of other studies in which analyses of variance

were used to determine the significance of differences between WISC-R and WISC. As in the present study, Larabee and Holroyd (1976) reported a significant test form effect for Verbal, Performance and Full Scale IQ. Similarly Klinge et al., (1976) reported significant test form, order of administration and test X administration interaction effects for Performance and Full Scale IQ scores, although they found that, in contrast to the present findings, none of the effects were significant for Verbal IQ.

It is possible to account for the lack of equivalence between WISC-R and WISC in terms of the changes made to WISC-R. Specific content changes, such as the elimination of the four analogy items in the Similarities subtest must be expected to affect the difficulty of the test. The new administration procedures for WISC-R, i.e. the administration of Verbal and Performance subtests in alternation may have a differential effect on item difficulties. The specific direction to the examiner 'to demonstrate the solution or provide the correct answer' (Wechsler, 1974, p.11) each time when a child fails the first item of a subtest, a direction not given to examiners of WISC, may provide sufficient explanation of the differential gains in IQ scores depending on which test was administered first as reported in the present and previous studies.

Comparison of Factor Structures

Two factor solutions for both WISC-R and WISC were indicated by the SCREE test (Cattell, 1966). However an elbow in the plot of the WISC-R eigenvalues suggested the possibility of two additional minor factors for WISC-R. The interpretation of the results of the maximum likelihood factor analyses varied depending on which of the two guides provided for the determination of the number of meaningful factors was used. The chi square criterion, which tests the hypothesis that the variance not accounted for by the factor solution for a given number of factors is due to random sampling error, indicated a two factor solution for WISC and a three factor solution for WISC-R. According to the Tucker and Lewis (1973) guide, two factors account for the data in the case of both tests. The Tucker and Lewis (1973) reliability coefficient is an estimate of the ratio of the amount of common variance accounted for by the factor solution in relation to the total common variance. The reliability coefficients obtained for the two factor solution were .99 for WISC and .87 for WISC-R, indicating that two factors reasonably accounted for the data. The WISC-R reliability coefficients were .94 for a three factor solution and .99 for a four factor solution. Although a two factor solution may have appeared

to be the most suitable, it was decided to rotate two, three and four factor solutions since the other studies mentioned above have reported a varying number of factors.

Two Factor Solution

The factor loadings, communalities and congruence coefficients for the two factor principal factor and maximum likelihood solutions are presented in Table 5.

The oblique rotation of two principal factors resulted in very similar structures for WISC-R and WISC. The first factor for both test forms was primarily a verbal factor with all five verbal subtests loading highly, and moderate loadings of the two performance subtests Picture Completion and Picture Arrangement. In both test forms the second factor was mainly a performance factor with Picture Completion and Picture Arrangement loading moderately and the other three performance subtests loading highly. The verbal subtest Arithmetic also loaded substantially on this factor. The correlations between the two factors were .63 for WISC and .60 for WISC-R. Congruence coefficients between WISC-R and WISC solutions were .99 for the first factor and .96 for the second. These values indicate a highly similar factor structure for the WISC-R and WISC. As further support for the validity of the factor structure obtained from the principal factor analysis, the oblique rotation of the maximum likelihood factor solution yielded a similar structure. Again the first factor was a verbal factor and the second factor a performance factor with a moderate Arithmetic loading. Similarly Picture Completion and Picture Arrangement loaded moderately and equally on both the verbal and performance factors. Correlations between the two factors were .62 for WISC and .61 for WISC-R.

Congruence coefficients between WISC-R and WISC solutions were slightly lower for the maximum likelihood solution than for the principal factor solution: .98 for the first factor and .92 for the second factor. Congruence coefficients computed for corresponding factors across the two factor extraction methods were .99 for both the WISC-R and WISC. It has been shown, therefore, that the two factor solution is stable across the extraction methods.

Because the factor structures are determined by relationships of subtests within the test, the similarity of the WISC-R and WISC factor structures does not necessarily imply that subjects are ranked similarly on the two tests. Least squares factor scores were computed and the relationship between the

Table 5 Oblique Rotations of Two Factor Solutions

	Principal Factor Solution						Maximum Likelihood Solution					
	Factor 1		Factor 2		Communalities		Factor 1		Factor 2		Communalities	
	Wisc	Wisc-R	Wisc	Wisc-R	Wisc	Wisc-R	Wisc	Wisc-R	Wisc	Wisc-R	Wisc	Wisc-R
Information	.76	.69	.08	.20	.66	.68	.79	.68	.04	.23	.68	.71
Comprehension	.93	.93	-.21	-.20	.65	.67	.95	.98	-.22	-.22	.69	.74
Arithmetic	.53	.50	.31	.37	.59	.60	.56	.40	.27	.46	.58	.60
Similarities	.77	.78	.10	.00	.69	.61	.75	.71	.13	-.07	.71	.57
Vocabulary	.84	.89	-.01	-.03	.70	.77	.86	.91	-.26	-.03	.72	.80
Picture completion	.32	.25	.28	.38	.29	.33	[illegible]	.22	.23	.37	.27	.28
Picture arrangement	.28	.32	.45	.26	.43	.27	.31	.34	.40	.21	.41	.25
Block design	-.01	-.03	.81	.78	.66	.58	-.03	-.08	.88	.83	.74	.62
Object assembly	-.15	-.09	.81	.55	.53	.26	-.13	-.02	.82	.48	.55	.22
Coding	.09	.03	.83	.64	.34	.44	.13	-.05	.49	.73	.33	.49
Congruence coefficients	.99		.96				.98		.92			

WISC-R and WISC factor scores was measured by correlating the factor scores for the two tests. The correlations were .93 for the verbal factor and .72 for the performance factor for both the principal factor and maximum likelihood solutions. This indicates that in addition to having similar factor structures, WISC-R and WISC also provide similar ranks for subjects in verbal and performance ability.

Three and Four Factor Solutions

The factor loadings for the three and four factor principal factor and maximum likelihood solutions are presented in Table 6.

The interpretation of the three factor solution was not particularly meaningful for either the WISC-R or the WISC. For the principal factor solution, the first factor was a verbal factor for both tests but the second and third factors differed and were combinations of various verbal and performance subtests. The three factor solution obtained from the maximum likelihood factor analysis indicated that the three factor structure was not stable across factor extraction methods. Maximum likelihood solutions provided very different patterns of loadings for WISC-R and WISC and neither pattern was meaningful or corresponded to the principal factor solution.

The results of the four factor solution were even less interpretable than the three factor solution. The solutions varied according to test form or factor extraction method used, and the fourth factor only accounted for about five per cent of the variance.

The two factor solution provided the most meaningful interpretation of the factor structures of both WISC-R and WISC. All guides to the determination of the number of appropriate factors indicated a two factor solution for WISC, but suggested the possibility of a greater number of factors for WISC-R. The lack of stability and clarity of the three and four factor solutions for WISC-R led to the conclusion that the two factor structure was more appropriate for both tests than the three or four factor solutions.

The two factors were basically verbal and performance factors with one verbal subtest (Arithmetic) loading on the performance factor and two performance subtests (Picture Completion and Picture Arrangement) loading moderately and equally on both factors. Kaufman (1975) also reported moderate loadings for Picture Arrangement and Picture Completion on the verbal factor obtained from the WISC-R standardization data. He suggested that these two performance subtests may require more verbal mediation than other performance subtests.

Table 6 Oblique Rotations of Three and Four Factor Solutions

	Principal Factor Solution						Maximum Likelihood Solution					
	Factor 1		Factor 2		Factor 3		Factor 1		Factor 2		Factor 3	
	Wisc	Wisc-R	Wisc	Wisc-R	Wisc	Wisc-R	Wisc	Wisc-R	Wisc	Wisc-R	Wisc	Wisc-R
Information	.61	.70	.14	.20	.18	.01	.07	.53	.84	.33	-.03	.09
Comprehension	.77	.85	-.05	-.23	.10	.11	-.19	.80	.74	.66	.21	-.09
Arithmetic	.45	.55	.57	.39	-.06	-.06	.24	.08	.43	1.00	.19	-.18
Similarities	.64	.82	.32	.04	.00	-.08	-.01	.60	.04	.32	.92	-.10
Vocabulary	.70	.90	.16	-.01	.07	-.02	-.03	.99	.57	-.17	.33	.18
Picture Completion	.13	-.02	-.16	.10	.64	.61	.25	.14	.46	.21	-.09	.24
Picture Arrangement	.10	.01	.08	-.05	.55	.68	.38	.29	.34	.08	.03	.21
Block Design	-.11	-.01	.58	.73	.33	.07	.81	-.15	-.24	.33	.34	.70
Object Assembly	-.27	-.01	.35	.57	.56	-.07	.82	.06	.09	-.12	-.17	.66
Coding	.08	.00	.67	.56	-.10	.15	.45	-.12	.16	.52	.04	.29

	Principal Factor Solution								Maximum Likelihood Solution							
	Factor 1		Factor 2		Factor 3		Factor 4		Factor 1		Factor 2		Factor 3		Factor 4	
	Wisc	Wisc-R	Wisc	Wisc-R	Wisc	Wisc-R	Wisc	Wisc-R	Wisc	Wisc-R	Wisc	Wisc-R	Wisc	Wisc-R	Wisc	Wisc-R
Information	.53	.52	-.12	.33	.25	.12	.19	.02	.61	.50	.09	.37	-.07	.00	.27	.08
Comprehension	.86	.78	-.08	-.03	.09	-.04	-.11	.13	.83	.72	-.06	1.00	-.11	.11	.09	-.11
Arithmetic	.25	.17	-.15	.86	.10	-.11	.64	-.10	.49	.10	.24	1.00	.10	-.08	.11	-.17
Similarities	.84	.54	.24	.49	-.17	-.14	.02	-.09	.82	.60	.00	.37	.25	-.10	-.13	-.07
Vocabulary	.76	.84	.00	-.05	.05	.24	.06	.02	.79	.99	.00	-.16	.00	.02	.08	.22
Picture Completion	.04	-.03	.03	.12	.62	-.02	-.08	.59	.04	.02	-.02	.20	-.07	.38	.69	.10
Picture Arrangement	-.05	.08	.03	-.08	.58	-.01	.18	.68	.08	.02	.02	-.08	.06	1.05	.60	-.07
Block Design	.15	-.11	.78	.40	-.11	.47	.05	.67	.07	-.13	-.05	.37	1.06	.04	-.10	.64
Object Assembly	-.10	.06	.69	-.04	.17	.64	-.04	-.04	-.20	.08	.07	-.09	.47	-.04	.40	.69
Coding	-.09	-.20	.05	.62	-.03	.12	.68	.12	.00	-.12	1.03	.53	-.02	.08	-.03	.24

The two factor Structure was very similar for WISC-R and WISC as indicated by congruence coefficients of .99 for the first factor and .96 for the second factor. The structure was also quite stable across extraction method with congruence coefficients of .99 for principal factor and maximum likelihood solutions.

The freedom from distractibility factor reported in other factor analytic studies of both the WISC-R and WISC was not detected in the present study. This factor has not been consistently defined by a specific subset of the subtests, but always comprises Digit Span and Arithmetic which are variously accompanied by Coding, Information, Picture Arrangement and Object Assembly. The factor structures obtained in the current study were based on inter-correlations of the ten required subtests and therefore did not include the optional subtests Digit Span and Mazes. Although Digit Span was not included in the present study, a freedom from distractibility factor would have been expected. If this factor were a stable and consistent factor in an oblique, simple structure solution, a freedom from distractibility factor lacking only the omitted digit span subtest should have emerged because of the invariance of oblique simple structure under sampling of variables (Thurstone, 1947). However, no factor was found comprising any of the other subtests associated with this factor. The freedom from distractibility factor did not emerge from either the WISC-R or WISC batteries for either of the two extraction methods.

Conclusion

The results of the present study replicate previous Australian findings by indicating that the informational overlap between WISC-R and WISC is lower than may have been expected. However, the internal structures of the tests are highly comparable.

The present study which was conducted on a representative sample of non-referred children showed a two factor solution to be most appropriate for both WISC-R and WISC. This two factor structure was highly consistent across factor extraction method and provided almost identical factor structures for WISC-R and WISC. The two factors were defined as verbal and performance factors which corresponds to Wechsler's model of intelligence. The total redundancies of WISC-R given WISC, and for WISC given WISC-R were approximately 60 per cent. This amount of overlap, the fact that most of it was due to a 'g' factor in both tests, and the similarity of structure and content suggest that the two tests measure similar dimensions, but that they are not equivalent.

Most of the differences between the tests can be expected to be of little consequence, except in cases of longitudinal studies and in other situations which require retesting with alternative versions of tests. In relation to the finding that WISC-R consistently yields a lower IQ estimate than WISC, it is important to note that this difference in IQ estimate will influence the intelligence classification (i.e. average, superior, etc. according to Wechsler's method) of the IQ level of indivuals. The classification of the IQ of a child may be dependent on whether the IQ is derived from WISC-R or from WISC; this is especially important for IQ estimates at the lower boundary of each category.

Keeping in mind the frequency with which intelligence classifications are attached to individuals to summarize the level of functioning, it becomes necessary for those making use of this 'shorthand' method of labelling to reconsider certain criteria for decision making which are based on broad IQ classifications.

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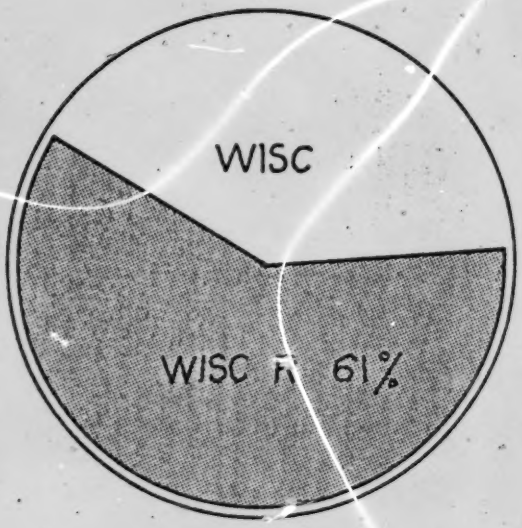
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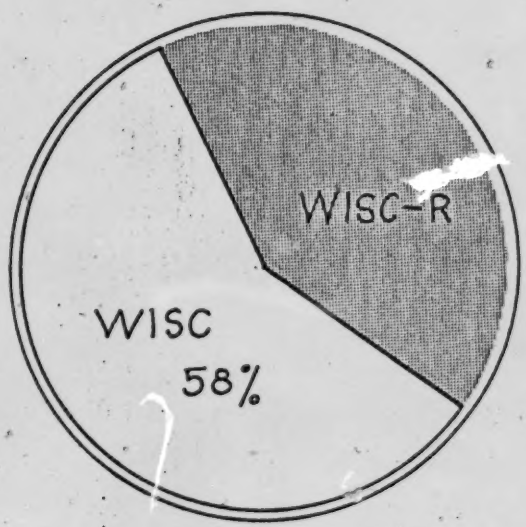
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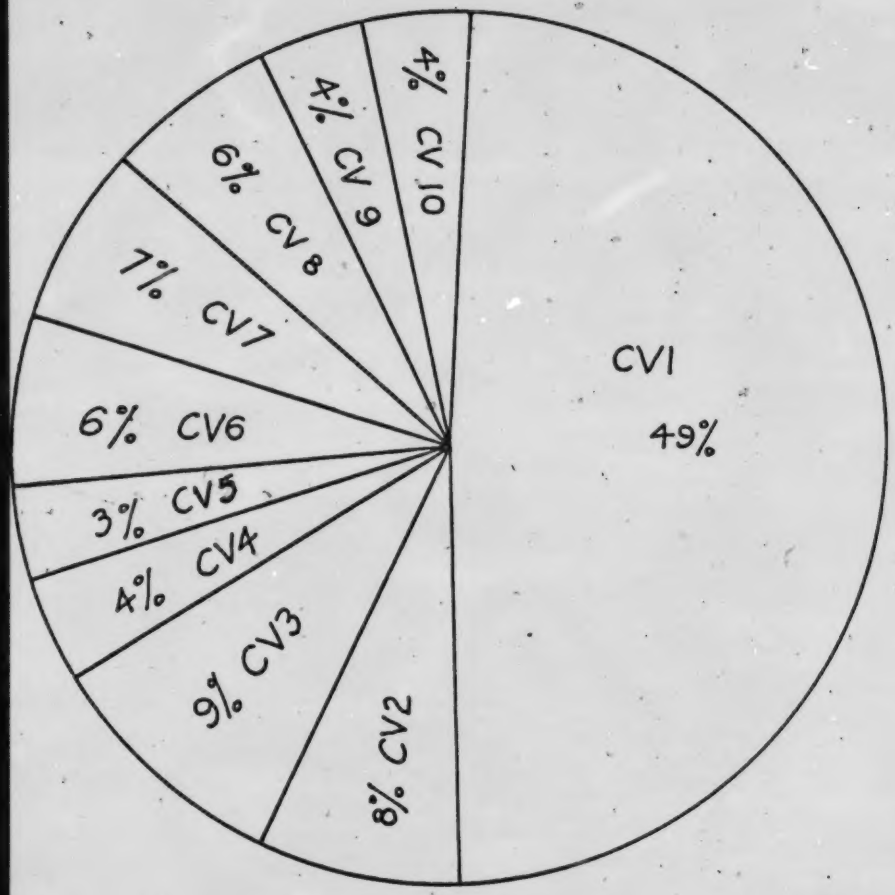
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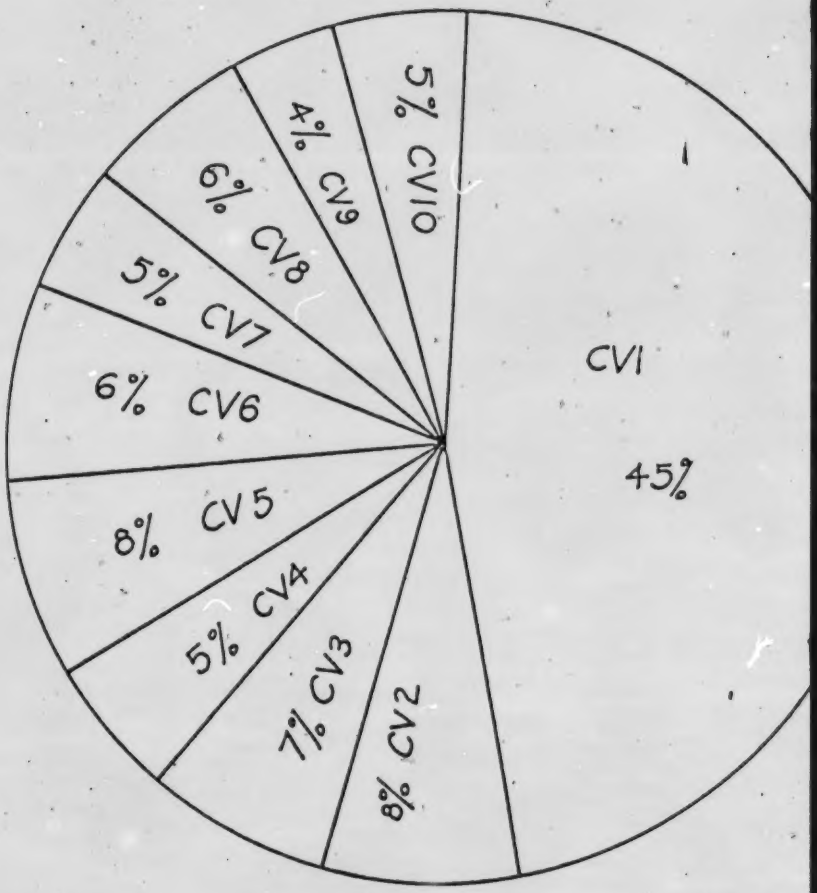
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